

# THE SOUTH YORKSHIRE STEEL INDUSTRY AND THE INDUSTRIAL REVOLUTION

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SHEFFIELD WAS A CUTLERY TOWN long before it became Steel City. The first documentary reference to a Sheffield cutler comes from 1297,<sup>1</sup> but steel was not made there until just after 1700. The town was known as a smoky centre of industry long before the first steel furnace was erected. In 1608 a friend of Gilbert Talbot, seventh Earl of Shrewsbury and lord of Hallamshire, wrote about his forthcoming visit to Sheffield and joked that he expected to be 'half choked with town smoke'.<sup>2</sup> A century later, Daniel Defoe observed that 'The town of Sheffield is very populous and large, the streets narrow, and the houses dark and black, occasioned by the continued smoke of the forges, which are always at work. The manufacture of hard ware, which has been so antient in this town is not only continued but much increased'.<sup>3</sup> By 'forges' Defoe meant cutlers' smithies. Long before the Industrial Revolution, Sheffield had a national reputation for the manufacture of knives. By the middle of the seventeenth century three out of every five men were described in the parish register as cutlers.<sup>4</sup> The story of the South Yorkshire steel industry must be seen against this background of centuries of industrial activity.

Where did the Hallamshire cutlers get the steel that was necessary for the sharp cutting edges of their knives before it was made locally? The Tankersley seam of ironstone, which ran through Sheffield Park, was used by medieval cutlers and was certainly important in getting the industry established, but it does not account for the subsequent triumph of the Sheffield cutlery industry. Long before the Cutlers' Company was formed in 1624 local craftsmen were working with foreign steel, which they obtained from the Basque Country via Bilbao, from Germany via Cologne and the Rhine, and from Sweden via Danzig and other Baltic ports. Such was the reputation of Hallamshire cutlery that transport costs from long distances could be absorbed in the prices of their products. The type of steel that was made in

<sup>1</sup> *Robertus le Cotelere*: was taxed in Sheffield; *Yorkshire Lay Subsidy 25 Edwardi I*, ed. W. Brown, Yorkshire Archaeological Society Record Series, xvi (1894), 76.

<sup>2</sup> Historical Manuscripts Commission, *A Calendar of the Shrewsbury and Talbot Papers*, II (1971), 296.

<sup>3</sup> D. Defoe, *A Tour through the Whole Island of Great Britain* (Everyman edition, 1962), II, 183.

<sup>4</sup> *Mesters to Masters: A History of the Company of Cutlers in Hallamshire*, ed. C. Binfield and D. Hey (Oxford, 1997), pp. 1–39.

Continental blast furnaces came from smelted iron ore of a better quality than was available in England. Such steel was a superior form of iron, which had carbon added to make it harder, more malleable and easy to grind to a cutting edge, and to hold that edge once it was made.

All our information from the period before Benjamin Huntsman first made crucible steel in 1742 comes from scattered documentary sources. No remains of the earliest steel furnaces survive in South Yorkshire and so far no site has been excavated. The pioneering work was that of Dr Kenneth Barraclough, who in his later years as a steelman completed a Ph.D. thesis at the University of Sheffield and subsequently published this in two volumes.<sup>5</sup> In 1991 I was able to add to his account for the period, 1660–1740,<sup>6</sup> and then Dr Nevill Flavell, another mature student of the University of Sheffield, discovered later documentary sources for his unpublished Ph.D. thesis, which was awarded in 1996.<sup>7</sup> Probate inventories from Chesterfield note the use of Spanish iron in 1537 and 1559<sup>8</sup> but the earliest Sheffield reference to imported steel comes from the account book of William Dickenson, bailiff of Hallamshire, who noted: ‘Rec[eived] from Bawetry the viij October 1574 vj Barrells of Steele w[h]ich was Layd in the stawre howse at Sheffield Castle’.<sup>9</sup> At that time, the local cutlery industry was organized through the manor court, and it seems that George Talbot, sixth Earl of Shrewsbury, took a personal interest in the trade, as he did in the local iron industry by introducing charcoal blast furnaces, and in the Derbyshire lead trade by building water-powered smelting mills.

During the second half of the sixteenth century — the first account of the process came from Prague in 1574 — someone in Central Europe invented the cementation process whereby bars of wrought iron were converted to what was commonly known as ‘blister steel’ because of the various-sized blisters that were raised on the surface.<sup>10</sup> It was also known in England as ‘Cullen steel’ because it came via Cologne or as ‘German steel’, but that became a generic name that was applied to cementation steel made in England during the later seventeenth century. We do not know whether the ‘German steel’ that was sold to Hallamshire scissor-smiths by the Cutlers’ Company in 1681 or the ‘parcel of German Steel’ recorded in the inventory of a Sheffield cutler in 1702 actually came from Germany or from English sources.<sup>11</sup>

The first evidence for steel making in South Yorkshire comes from a letter of 1642 in which Charles Tooker of Rotherham complained to Sir John Reresby about the destruction of his steel works by Parliamentary troops at the beginning of the Civil War.<sup>12</sup> Tooker had arrived from Somerset and lived at Moorgate Hall, Rotherham,

<sup>5</sup> K. C. Barraclough, *Steelmaking before Bessemer: 1. Blister Steel, the birth of an industry; 2. Crucible Steel, the growth of technology* (The Metals Society, 2 vols, 1984).

<sup>6</sup> D. Hey, *The Fiery Blades of Hallamshire: Sheffield and its Neighbourhood, 1660–1740* (Leicester, 1991), pp. 179–95.

<sup>7</sup> N. Flavell, ‘The Economic Development of Sheffield, c. 1740–c.1820’ (unpub. Ph.D. thesis, Sheffield Univ. 1996).

<sup>8</sup> *Chesterfield Wills and Inventories, 1521–1603*, ed. J. M. Bestall and D. V. Fowkes, Derbyshire Record Society, 1 (1977), 17 and 95.

<sup>9</sup> Sheffield Archives, MD 192.

<sup>10</sup> Barraclough, *Steelmaking*, I, 48–50.

<sup>11</sup> Hey, *Fiery Blades*, p. 184.

<sup>12</sup> West Yorkshire Archives Service, Leeds, MX/R IF. I owe this reference to Dr Edgar Illingworth. Tooker was making steel at Thrybergh in 1664; see Rotherham Archives, Tooker deeds, 2/1.

but whether his steel works was in Rotherham or Thrybergh (where he is known to have had a furnace later on) is not clear. We do not know whether he had previous experience of steelmaking or why he migrated north. Another early owner of a steel works was Lionel Copley, the ironmaster of Wadworth Hall, who had a steel furnace in Kimberworth recorded in the hearth tax returns of 1672.<sup>13</sup> Such isolated finds in perhaps unexpected sources indicate the fragmentary nature of the evidence. Tooker and Copley were typical of men from gentry families, such as the Sitwells of Renishaw Hall, Derbyshire, and the Spencers of Cannon Hall, Cawthorne, who prospered by investing in the metal trades.

The earliest English steel works were cementation furnaces that were modelled on those that had long been in use in Germany. During the late seventeenth and early eighteenth centuries several furnaces were erected in the rural district south-east of Sheffield by minor gentry or yeomen families — the Ardrons of Treeton, the Harrisons of Orgreave and the Staceys of Ballifield — and by John Fell, the clerk at Attercliffe Forge, where iron had been forged since the 1570s. The evidence comes from deeds, wills, inventories, and maps.<sup>14</sup> Samuel Shore, the son of a Sheffield mason and a prominent member of the Upper Chapel congregation, built furnaces at Darnall and Woodhouse and about 1709 became the first person to build a steel furnace in Sheffield, on the site of the demolished castle. Soon afterwards, he erected a pair of furnaces at the then northern edge of the town in what became known as Steelhouse Lane, a site that is shown on Thomas Oughtibridge's view of Sheffield in 1737. Shore was also an ironmaster and a merchant, the first to rise from a humble background to a prominent position in the town, and his descendants became landed gentry at Norton and Tapton. Another early steel master was Thomas Parkin, a member of an old Hallamshire family based at Mortomley who had long been involved in the metal trades. He had built a cementation furnace at Balm Green, on the western edge of the town, by 1716. His descendant and heiress, Elizabeth Parkin, was the 'Queen of the Sheffield Assembly' until she retired to her new house at Ravenfield Park. The well-known pattern whereby the original entrepreneur lived close to the works that he had created but his descendants became landed gentry was established well before the great events that we still label 'The Industrial Revolution'.

So we now know something about the first steel masters and the nature of their furnaces. By 1740 enough cementation steel was probably being made in and near Hallamshire to meet local demand. The South Yorkshire steel industry took root and flourished because the expanding cutlery industry provided a ready market for its products. Thanks to Dr Barraclough, we have a thorough understanding of the technicalities of making cementation steel. He showed that visitor's descriptions from the second half of the eighteenth century, such as those of Gabriel Jars in 1765 or Charles Hatchett in 1796, tallied with the methods that were still in use in the first half of the twentieth century. Victorian Sheffield had about 260 cementation furnaces, but the only one to survive intact is that which was built in the 1830s by the firm of Daniel Doncaster in Hoyle Street. The making of cementation steel at this site was filmed in 1951, so we have an accurate record of the process.<sup>15</sup>

<sup>13</sup> The National Archives: Public Record Office, E179/262/15.

<sup>14</sup> This paragraph is based on Barraclough, *Steelmaking*, and Flavell, thesis.

<sup>15</sup> This furnace is photographed and described in D. Hey, *A History of Sheffield* (Lancaster, 1998), pp. 68–69.

By the middle years of the eighteenth century the grinding wheels and corn mills on Hallamshire's rivers were accompanied by a growing number of tilt hammers for reducing bar iron and steel. Three 'tilts' of a design first used in Germany were at work in Hallamshire by 1740, fifteen by 1750. Here again, we see that a landlocked place like Sheffield was nevertheless receptive to new technology from central Europe. The South Yorkshire Industrial History Society, founded 70 years ago (albeit under a different name), is the oldest society of its kind in the country, and its members have been active in preserving and researching the history of local industries. The tilt forge that the Goddards built in 1785 at what is now the Abbeydale Industrial Hamlet is the finest surviving local example and Hallamshire's best-preserved crucible works is on the same site. From now on we have standing structures as well as documentary evidence to guide us and the expertise of industrial archaeologists, many of them drawing on their own work experience, to interpret them.

Benjamin Huntsman, the Doncaster clock maker who had been born in Epworth in 1704 of Quaker parents, fully deserves his old reputation as a hero of the Industrial Revolution whose discovery of a method of making high quality steel in crucibles was the most important ever made in Sheffield. Dr Barraclough has shown that his superior steel gained world status for Sheffield, enabled Hallamshire to overtake London as the leading centre of cutlery production, and stimulated the rapid growth of an edge-tool industry for which Sheffield soon had an international reputation. Huntsman moved to Handsworth in 1742 so as to be at the heart of the South Yorkshire cementation steel-making district, and after many years of trial and error he perfected a method of making 'cast steel', which was 'refined' from the ends of bars of cementation steel in clay pots or 'crucibles' fired to a high temperature. It remained the chief method of casting an ingot of steel until Bessemer invented his converter over a hundred years later. Before Huntsman, the Sheffield steelmaking district had little or no reputation outside the area, but by 1820 Hallamshire was probably almost as well known nationally and internationally for its steel as for its cutlery. By the mid nineteenth century the Sheffield district made 90 per cent of British steel and nearly half the European output. Yet Huntsman kept his invention secret and for twenty years he had no real competitors. He was satisfied with a relatively small business and the house that he built in Attercliffe Green is a modest one. He never acquired the wealth to become a great benefactor.<sup>16</sup>

From the 1760s the production of high-quality crucible steel increased, but it remained on a very much smaller scale than that of cementation steel. As the number of firms making cementation steel rose and the size of furnaces increased Sheffield became increasingly polluted. The growth in the number of firms is evident from the trade directories, but the increase in the size and number of furnaces is not well documented and unfortunately we have few production figures to quantify the advance. We know from the earliest trade directories that by the 1780s the largest firms, notably that of John Marshall of Millsands, had both types of furnaces and Dr Flavell has shown how the increasing integration of the two steel processes is evident from the entries in later directories; in fact the 1821 Sheffield directory has a large combined category. The history of Marshall's works is poorly documented, with just a few leases, maps, and a will to guide us,<sup>17</sup> but in the last two years the ARCUS team

<sup>16</sup> K. C. Barraclough, *Benjamin Huntsman, 1704-6* (Sheffield, 1976).

of archaeologists at Sheffield University have excavated the Millsands site in advance of the building of an inner ring road and have identified a single-chest, stone-built cementation furnace of the 1780s, two double-chest cementation furnaces that probably date to the first quarter of the nineteenth century, and a crucible furnace. This is the first time that such a site has been excavated and the archaeologists have shown that the size of the operation was considerable. Standing structures also reveal the size and nature of the largest integrated firms of the first half of the nineteenth century. The best surviving example from the prosperous 1840s and 1850s is the brick-built, steam-powered Butchers' Wheel in Arundel Street, where William and Samuel Butcher, who had inherited a cutlery business that went back to 1725, made steel, files, razors, chisels, planes and high-quality cutlery, pocket knives and Bowie knives for the American market. Such buildings have been surveyed by Dr Victoria Beauchamp for her University of Sheffield Ph.D., awarded in 1996.<sup>18</sup> We now need, business histories of individual firms, wherever sufficient documentation survives.

Arnold Toynbee coined the term Industrial Revolution to describe the period of massive industrial change in the later eighteenth and early nineteenth centuries. He argued that change was manifest in large-scale production, the use of steam-powered machinery, the employment of large numbers of people under one roof, and the expansion of markets. These changes were associated with population growth and urbanisation, and they were particularly marked in the cotton and iron industries. Although we lack production figures, the Sheffield steel industry fits this model reasonably well, but the associated cutlery industry does not. Small works in the back streets remained the typical units of cutlery production, and water remained a more important source of power than steam. The manufacture of cutlery expanded through a multiplication of small units of a traditional kind. Greaves's Sheaf Works, which opened in 1823 four years after a canal had connected the Don navigation to the heart of the town, is regarded as Sheffield's first self-contained factory, by far the largest business in the town at that time. The workers there converted and melted cementation steel, made their own tools, and then produced razors, penknives and other cutlery wares, especially for the American market.

In the first half of the nineteenth century the steel industry was still dependent on the handicraft skills of its workforce. A clever, hard-working, risk-taking mechanic could make his fortune, however humble his beginnings. The trade was easy to enter, as Huntsman had shown, and nearly all the capital that was invested came from local sources. The subsequent history of the Sheffield and Rotherham steel industry has been well covered by Dr Geoffrey Tweedale, who has shown how the American market was largely responsible for the remarkable expansion of the Sheffield crucible steel industry between the Napoleonic Wars and the American Civil War.<sup>19</sup> In good years a third or more of the town's steel output was sent across the Atlantic, in addition to the vast trade in cutlery and edge tools. Large fortunes were made from the American trade by the steel firms of Sanderson, Jessop, Vickers, Greaves, Butcher, and Cammell.

<sup>17</sup> Sheffield Archives, Fairbank, SheS 1494S; ACM lease book, S379, fol. 232

<sup>18</sup> V. A. Beauchamp, 'The Workshops of the Cutlery Industry of Hallamshire, 1750–1900' (unpub. Ph.D. thesis, Sheffield Univ. 1996).

<sup>19</sup> G. Tweedale, *Steel City: Entrepreneurship, Strategy, and Technology in Sheffield, 1743–1993* (Oxford, 1995).

By 1851 the population of the new borough of Sheffield was 135,310, compared with the 14,531 of 1736. Clearly, the changes had been enormous. Yet the steel industry of the classic period of the Industrial Revolution was small when compared with what was still to come. A new phase began in 1837, as Sheffield was being connected to the national rail network at Rotherham, when Spear & Jackson, saw makers, moved out of town to the flat lands in the east end of the parish, where they founded their Aetna works, thus starting a tradition of naming steelworks after volcanoes or mythological giants: Hecla, Atlas, and Cyclops.<sup>20</sup> The building of railways throughout the world created a demand for steel and for machine tools, and Sheffield firms responded quickly. The steel manufacturers no longer regarded the cutlers as their main customers. At first, the steel that was produced in the east end of Sheffield was made in crucible and cementation furnaces, but from the 1860s it was largely manufactured by new methods, starting with the Bessemer converter. These new developments allowed Sheffield to retain its position as the world's most famous steel-manufacturing centre.

The owners of the east-end steelworks — Charles Cammell, Edward Vickers and his sons, Thomas Firth and his sons, John Brown and Thomas Jessop — were practical men, experienced in the local trades. Thomas Firth, for example, started in 1842 with six crucible holes and only a few employees. The town centre could not accommodate large businesses, whereas the east end offered space, low rents and level sites next to the railway, which could import coke and coal and export finished products. In 1858 Henry Bessemer moved from London to open a works in Carlisle Street, and Sheffield steelmakers soon began to take out licences from Bessemer that allowed them to install their own converters; Brown 1860, Cammell 1861, Samuel Fox 1862. The age of bulk-steel manufacture had begun. By 1870 more steel was made by the Bessemer process than in crucibles, though the old method continued to produce steel of a higher quality than did the converters. The Bessemer process replaced the wrought iron industry and allowed Brown's and Cammell's to build up a very profitable trade in rails, but it was unsuitable for cutlery and edge tools and the more critical applications.

The sixty years between 1860 and 1920 were a time of great ingenuity in the production of special steels. Most of the major alloy steels — those that owed their remarkable properties to elements other than carbon — were discovered before the First World War. The two outstanding discoveries were those of manganese steel by Robert Hatfield in 1882 and of stainless steel by Harry Brearley in 1912, but there were many more as Sheffield steelmaking became science-led. By 1890 both America and Germany had overtaken Britain as bulk producers of steel, but Sheffield remained the leading international centre for special steels. It had also become one of the greatest producers of armaments that the world had ever known. The arms race up to the First World War filled the order books of Sheffield's steel firms — Vickers, Brown's, Cammell's, Hatfield's, and Firth's. Meanwhile, Sheffield's population had grown from 135,310 in 1851 to 380,793 in 1901, or well over 400,000 if newly incorporated areas are added. Clearly, the events of the classic period of the Industrial Revolution were completely overshadowed by those of the reign of Victoria.

<sup>20</sup> This and the next two paragraphs are based on D. Hey, M. Olive, and M. Liddament, *Forging the Valley* (Sheffield, 1997).